Energy Storage and Social Equity

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Energy Equity: Topics for Discussion Today

- Energy storage as a social equity asset
- Energy storage demonstration and community technical assistance
- Equity metrics for grid performance
- Planning and investing in the grid with equity as an objective
- Storage as part of the clean energy transition

Links Between Energy Storage & Community Objectives

WHY **ENERGY STORAGE**?

Locational flexibility

Wide applications

Broad uses for storage

HOW CAN ENERGY STORAGE SUPPORT **COMMUNITY GOALS** AND ADDRESS **NEEDS?**

Access

Affordability

Environmental Impact

Social Impact

Decarbonization

Resiliency

Energy Justice and Energy Storage

Energy Justice Tenets	Energy Inequities	How Energy Storage Fits
Distributive Justice (where?) The unequal allocation of benefits and burdens and unequal distribution of the consequences **Recognition Justice (who?)** The practice of cultural domination, disregard of people and their concerns, and misrecognition **Procedural Justice (how?)** The fairness of the decision-making process **Restorative Justice** The response to those impacted by the burdens of energy projects	**Energy Burden** Percent of income spent to cover energy cost. **Energy Insecurity** The inability to meet basic household energy needs. **Energy Poverty** A lack of access to basic, life-sustaining energy. **Energy Vulnerability** The propensity of a household to suffer from a lack of adequate energy services in the home.	• Curb demand charges • Reduce affordable housing energy cost • Maintain operation in facilities critical to public health and safety • Reduce utility disconnection • Support grid reliability and resilience (backup power) • Intentional siting in underserved communities • Serve remote communities • Support energy independence • Generate community wealth

Additional readers:

- Energy Storage as an Equity Asset. *Current Sustainable Renewable Energy Reports* 8, 149–155 (2021). https://doi.org/10.1007/s40518-021-00184-6
- Energy Storage for Social Equity https://www.pnnl.gov/projects/energy-storage-social-equity
- Community Energy Storage and Energy Equity, 2021. https://www.pnnl.gov/sites/default/files/media/file/Community%20Energy%20Storage%20Memo.pdf

Energy Storage for Social Equity (ES4SE)

Initiative Overview

ES4SE Distinctions

What makes this program unique?

- Easy Access and Targeted Outreach
- Eligibility is linked to need
- Focus on the problem with many possible solutions
- Workforce and equity are part of the assistance
- Community of Communities
- Direct connection to future project funding

ES4SE Program Overview

Goal: *support disadvantaged communities affected by unreliable and expensive energy systems. Through this program, eligible communities have access to direct, non-financial technical assistance and potential support for new energy storage project development and deployment.*

- Application Process → Technical Assistance
- Technical Assistance → Project Development & Demonstration → Deployment
- Existing Project Pipeline → Project Development & Demonstration
- Existing Project Pipeline → Deployment

OUTCOMES

Connect disadvantaged communities with energy solutions that support equitable outcomes	**Demonstrate** the role of energy storage in energy equity	**Develop** methods and metrics to analyze impact of investment on equity	**Report** on lessons learned and best practices to support future work across DOE	**Grow** and strengthen DOE project pipeline

Eligibility & Selection Criteria

Eligibility Criteria

- Technical assistance will be **beneficial** to a disadvantaged community
- Disadvantaged community experiences problems or challenges with their energy system that **can be addressed** or partially mitigated through electric service delivery and/or energy storage
- Applicant must have the **capacity** to support the technical assistance process
- Applicant must have **credibility** to support the disadvantaged community

Selection Criteria

- Impact potential of energy storage to contribute to community objectives
- Unique value of laboratory analysis (limited funding, need for scoping work, potential public benefit, etc.)
- Strength of team described in the application to support the technical assistance process, develop a cohort with other participants, and support the community.
- Likelihood of technical feasibility to enable implementation of solution identified in technical assistance.
  Note: this program does not include implementation/demonstration/deployment

Results of the Technical Assistance

Technical Assistance Results in a Project Development Framework including:

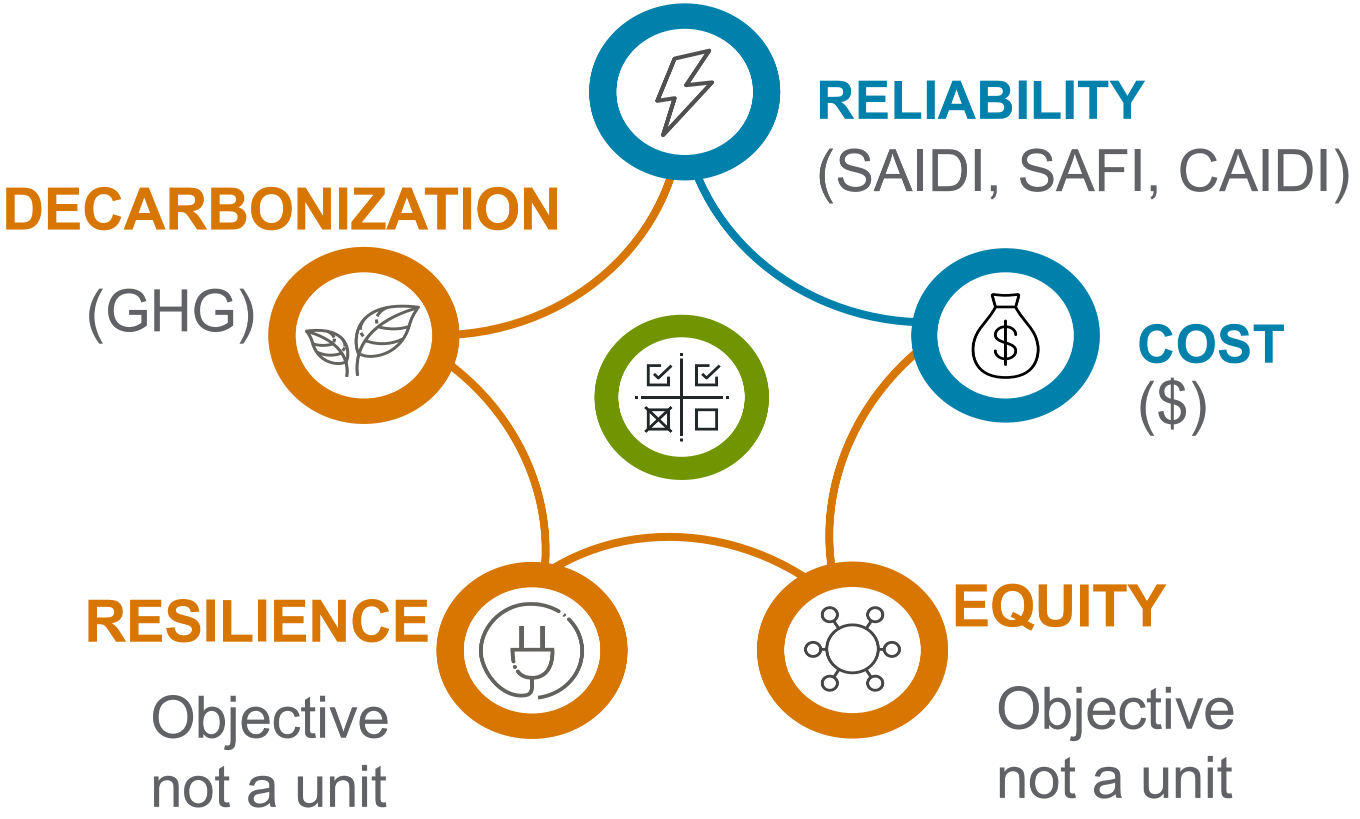
- **Technical feasibility**: siting, sizing, site-specific considerations
- **Economic benefits**: direct energy savings and indirect economic activity
- **Social equity benefits**: workforce development, decarbonization, decreased pollution, reduced energy burden
- **Finance and contractual feasibility**: options and identification of stakeholders

Technical Assistance moves the project from idea to plan

Grid Planning for Equity

Emerging Objectives in Grid Planning

- Traditionally electric grid planning strives to maintain **safe, reliable, efficient, and affordable** service for current and future customers.
- As policies, social preferences, and the threat landscape evolve, additional considerations for power system planners are emerging, including **decarbonization, resilience, and energy equity and justice**.
- Relative to traditional objectives, these emerging objectives are not well integrated into grid planning paradigms.



Equity in Grid Planning: Current Practice

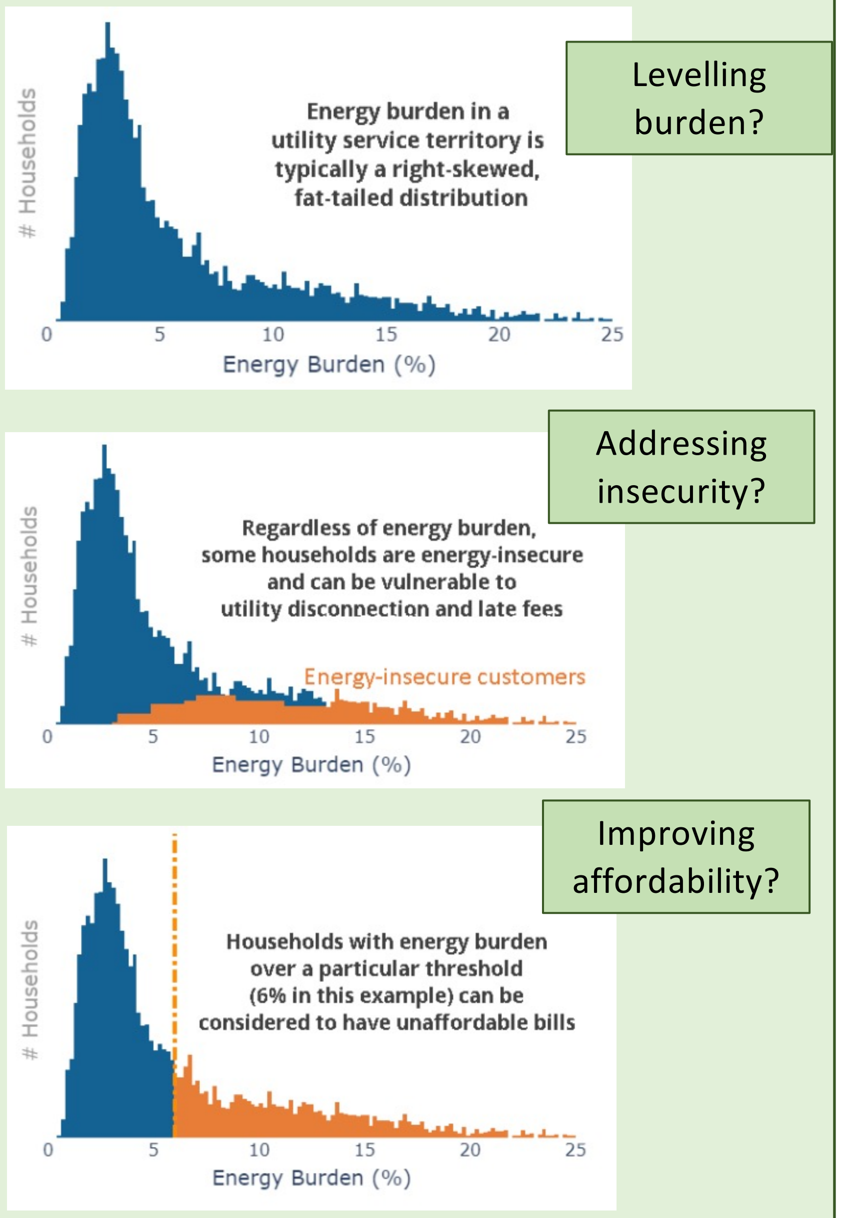
Remain tied to decarbonization goals and/or environmental justice.

- **Michigan**: 2020 Executive Order requires PUC to expand its environmental review of IRPs to evaluate whether utilities are meeting state decarbonization goals
  - Also requires PUC to assess whether IRPs consider environmental justice and health impacts
- **Washington**: 2019 Clean Energy Transformation Act requires IRPs to include an assessment of energy and non-energy benefits and reductions of burdens to vulnerable populations
- **Connecticut**: 2019 Executive Order requires the Public Utilities Regulatory Authority to analyze decarbonization pathways consistent w/ the state's goal of 100% carbon-free electricity by 2040
  - EO also calls for PURA oversight to ensure energy affordability and equity for all ratepayers during the resource planning process (but this is loosely outlined)
- **California**: 2018 CPUC decision requires IRPs with LSEs to assess their impacts on disadvantaged communities
  - CA defines disadvantaged communities as those w/ the highest pollution burden (top 25% statewide)

Planning Paradigm	Treatment of Equity Within Paradigm
Integrated Resource Planning	**Limited**
Transmission Planning	**None**
Distribution System Planning	**None**
Reliability Planning	**None**
EE & DSM Planning	**Limited**
Integrated Distribution Planning	**Limited**

Translating Energy Equity Policy to a More Equitable Grid

Output Metrics



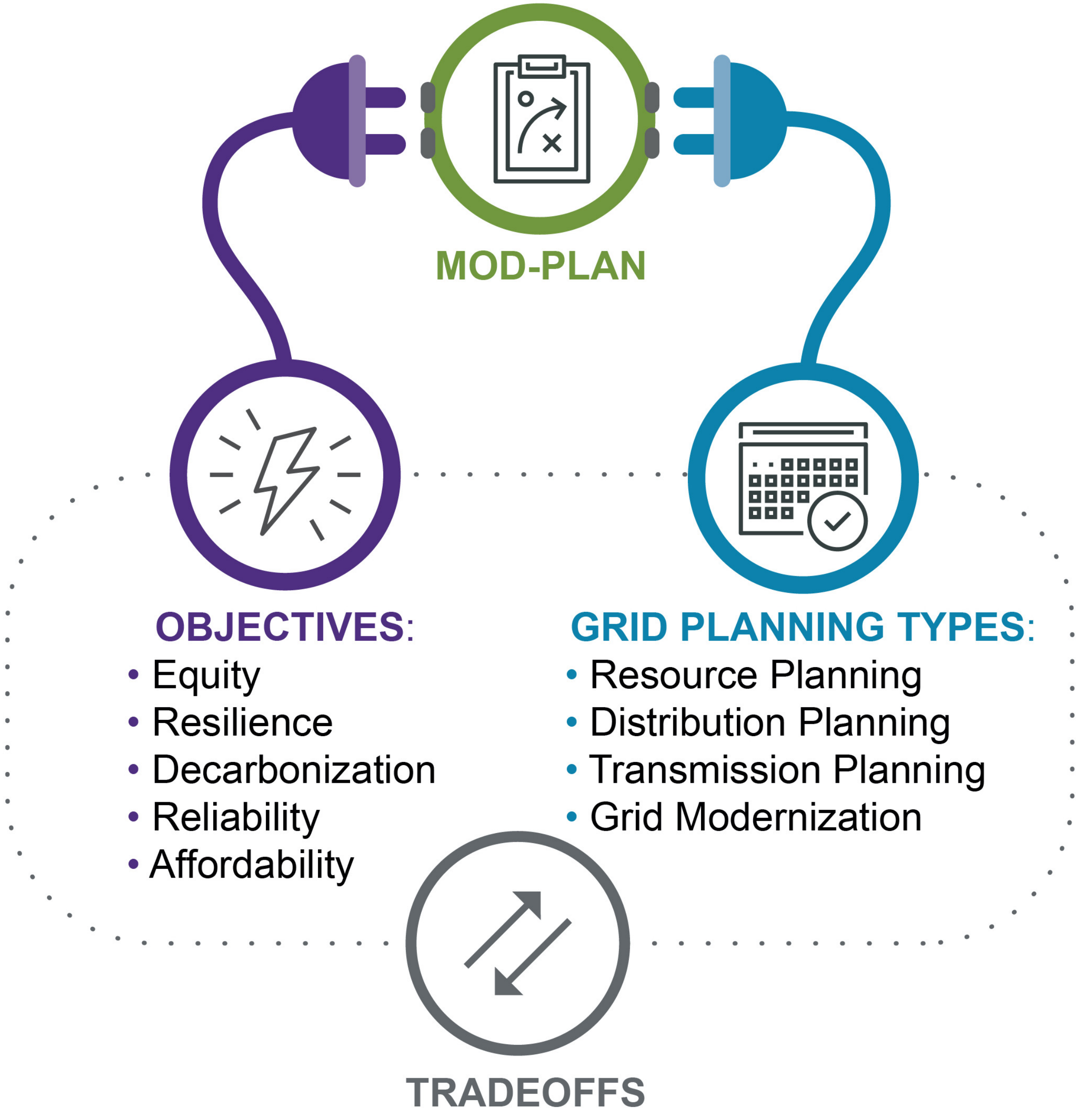
- **New Analytical Framework Required**
  - Different from siting a facility or a discrete decision under environmental justice framework
- **Grid Planning Scales**
  - Distribution system planning is useful first framework – spatial in nature, closely connected to community experience
- **Missing Insights on Investments to Effects**
  - No one single attribute of the grid is sufficient for energy equity – may be composite or index until clearer insights about which are the most meaningful in practice
- **Tradeoffs and Co-Optimization**
  - Strong relationships, including tradeoffs, with other objectives

MOD-Plan: Multi-Objective Decisionmaking

Funded by the Office of Electricity

https://energy.sandia.gov/programs/electric-grid/mod-plan/

- **Planning frameworks with stakeholder roles.** Develop a framework that applies multiple emerging objectives in the electric grid planning processes with stakeholder roles throughout
- **Emerging objectives and trade-offs.** Advance innovative and practical methods for formulating planning objectives for decarbonization, resilience, and energy equity to indicate trade-offs
- **Metrics for success.** Develop and report on metrics that can measure the performance of the grid with respect to these emerging objectives

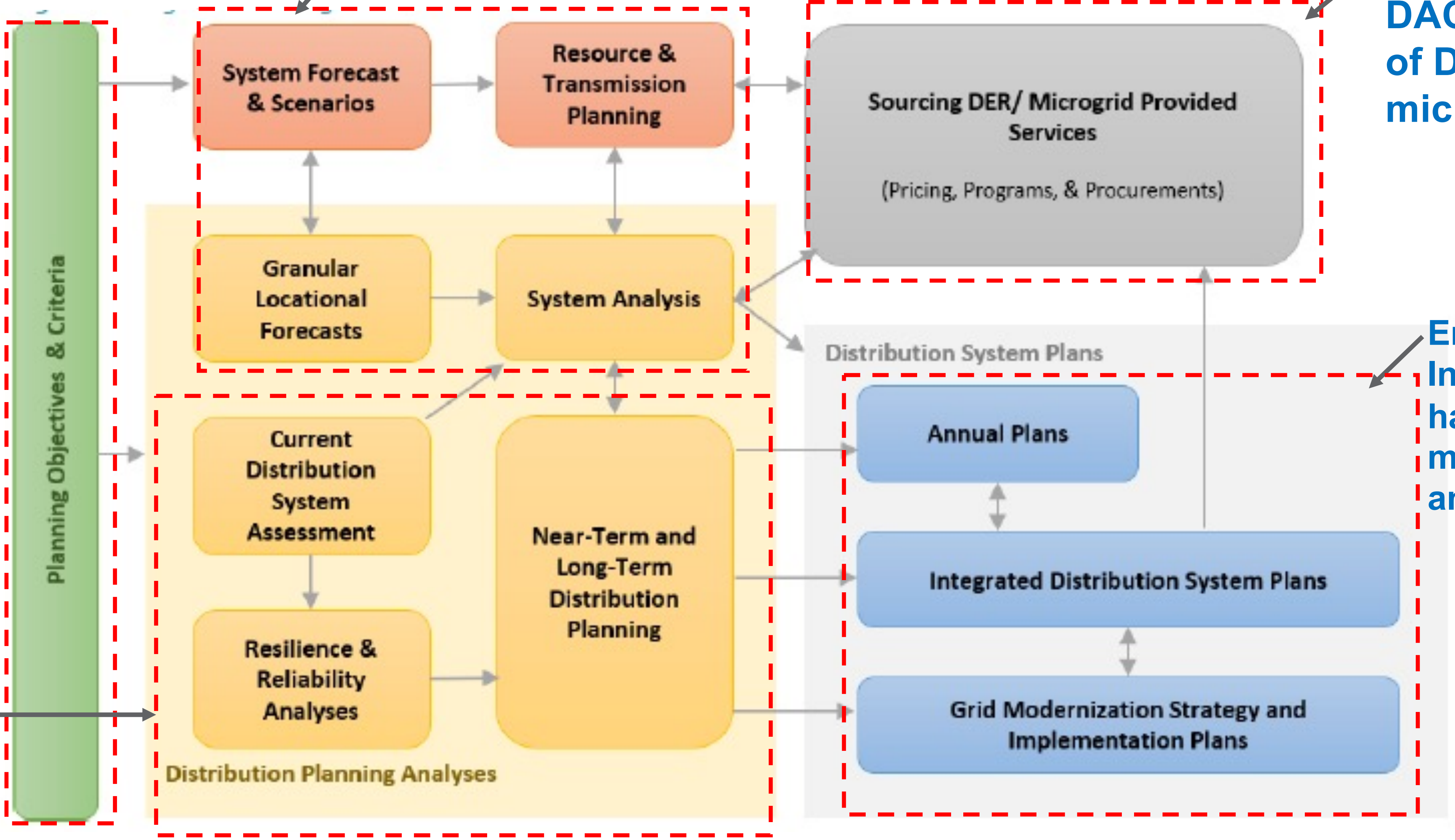


Incorporating Energy Equity within the IDP

Energy Burden: Trading & Weather/Climate forecasts that impact energy costs.
EJ & CJ impacts

Energy Democracy: DACs ownership of DERs and microgrids.

Energy Equity: Identify stakeholders and DACs in iterative feedback process for creation of policies



Energy Insecurity: Grid hardening, modernization, and energy rates

Assess environmental land climate impacts to DACs, siting RE, EES, and mining of resources for technology.

Simulation Approaches

Planning Results
- Number /type of DERs to meet capacity
- Storage and DGs to firm DERs
- Equipment upgrades
- Rate increase/decrease

Exogenous Inputs

Expected Load/DER profiles

Optional upgrades

List of possible contingencies

Area specific Demographic insights

Energy Burden data

Energy Affordability

Energy Insecurity

Top Level Problem

Energy balance problem (planning processes)

Budget

Reserve Requirements

Projected Net Load Growth

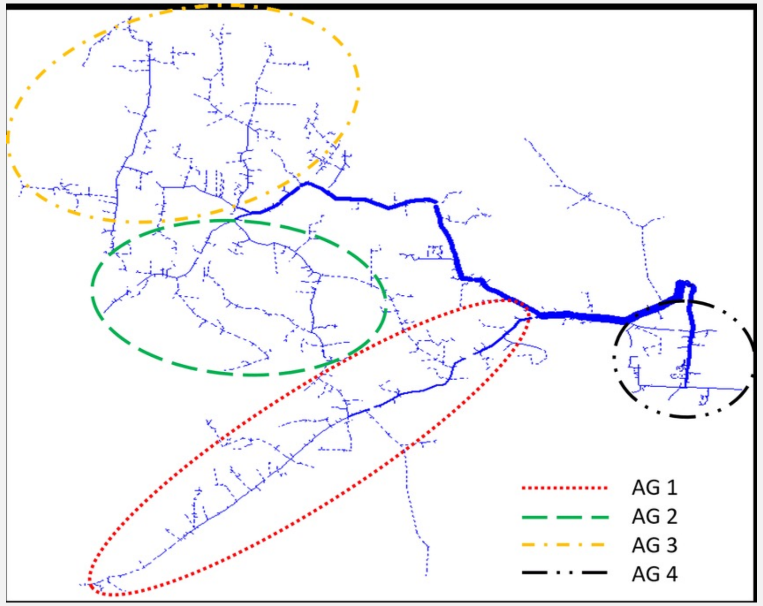
Projected net consumer DER adoption

Demand Response Incentive

Cost of critical upgrades

Decarbonization Goals (State or Federal mandates)

Monte Carlo Simulation on feeder map

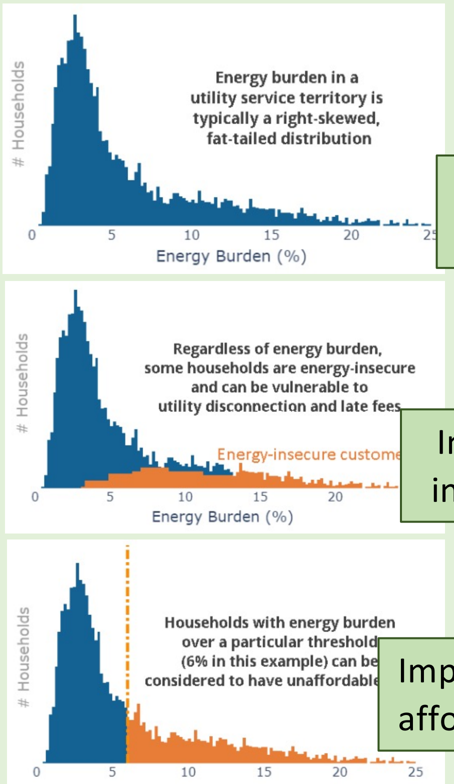


- 5- minute data (yearly) simulation
- Calculate energy bills for consumers at the current rate
- Record voltage/overloads
- Record effect of contingencies and recovery time
- Compute energy burdens based on demographic data

Statistical Post processing

Output Metrics

Equity



Levelling burden?

Improving insecurity?

Improving affordability?

Do upgrades to reduce interconnection cost in underprivileged communities?

Resiliency/ Loss of load (SAIFI/SAIDI/other)

Decarbonization - Energy from DERs

Reduced Pollution – impact on Equity

For current strategy calculate sensitivities:
- DER locations/upgrades to Equity
- DER locations to resiliency
- rate change to equity

Adjust planning problem inputs
- Vary DER locations and quantity
- Modify essential upgrades based on equity
- Vary Budget to affect rate change

ENERGY STORAGE FOR SOCIAL EQUITY

Equity Metrics

Grid Performance Metrics

- *Metrics* for new objectives that lack national standardization and quantification practice, yet there is new strong recognition that the grid must improve in this way.

RESILIENCE	**Attribute-Based**	**Performance-Based**			
		Power System Performance	Economic Consequence	Social Consequence	National Security Consequence

EQUITY	**Procedural and Recognition** *(due process and accountability)*	**Distributive** *(affordability and availability)*	**Restorative** *(intra- and inter-generational sustainability and responsibility)*

DECARBONIZATION	**Emissions**	**Resources**

Measuring Equity

Target Population Identification

- Program equity index
- Program accessibility
- Energy cost index
- Energy burden index
- Late payment index
- Appliance performance
- Household-human development index

Investment Decision Making

- Community acceptance rating
- Program funding impact
- Energy use impacts
- Energy quality
- Workforce impact

Program Impact Assessment

- Profits
- Program acceptance rate
- Energy savings (MWh)
- Energy cost savings ($)
- Energy burden change
- Change in household-human development index score

Energy Equity Metrics for Grid Planning

*In the context of grid planning, equity is defined as the ability of the electricity system to **equitably distribute costs and benefits**—including the allocation of burdens and opportunities in the transition to a more sustainable energy sector—with attentiveness to the **procedural, recognition, distributive, and restorative dimensions of energy justice**.*

Procedural and Recognition *(due process and accountability)*	**Distributive** *(affordability and availability)*	**Restorative** *(intra- and inter-generational sustainability and responsibility)*
• Representativeness and inclusiveness of planning processes for all affected stakeholders • Responsiveness of planning processes to public participation and fairness of decisions • Transparency of planning processes and decisions	• Electricity cost burden (i.e., household electricity bills/income) and affordability gap • Electricity quality (e.g., geographic disaggregation of outage frequency/severity; restoration efficiency) • Electricity program (e.g., tax credits; energy efficiency) and technology (e.g., BTM solar and storage) accessibility and performance (e.g., participation/investment demographics; distribution of savings/costs, reliability/resilience, or other benefits/burdens) • Social burden (i.e., effort and ability to access critical services in grid disruptions)	• Economic (e.g., job training/job quality; energy resource ownership/governance; reparation of electricity cost burden shouldered by energy burdened communities) • Environmental (e.g., natural resource replenishment; generation/storage resource siting) • Social (e.g., improvements in household-human development index; establishment of safeguard/grievance redress mechanisms)

Actions that Influence Equity and Metric Outcomes

Recognition

- Ending disconnections (e.g., commitment to reduce or end disconnections, moratorium on shutoffs for customers with severe or extreme energy burdens)
- Maximizing resilience, minimizing vulnerabilities (e.g., targeted program investments for communities and households facing severe climate and health risks)

Distributive

- Maximizing co-enrollments in affordable rates, payment plans, and clean energy programs (e.g., notify disadvantaged customers of the programs they qualify for)
- Enabling energy affordability (e.g., commitment for reducing the distribution of high energy burdens)

Restorative

- Integration in cross-sector and long-term planning (e.g., quantitative and qualitative treatment of equity in long term plans and models)
- Wealth building (e.g., on-bill financing with special terms for disadvantaged customers, no caps on DERs and storage)

Procedural

- Enabling participation (e.g., participation stipends, intervenor funding for disadvantaged community engagement)
- Unbiased evaluation (e.g., no conflict-of-interest w/ third party evaluators, evaluation open for public input, access to original data)

Reading Material

- **Review of Energy Equity Metrics, 2021.**
- Summary: https://www.pnnl.gov/sites/default/files/media/file/Metrics%20for%20Energy%20Equity_0.pdf
- Full Report: https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-32179.pdf

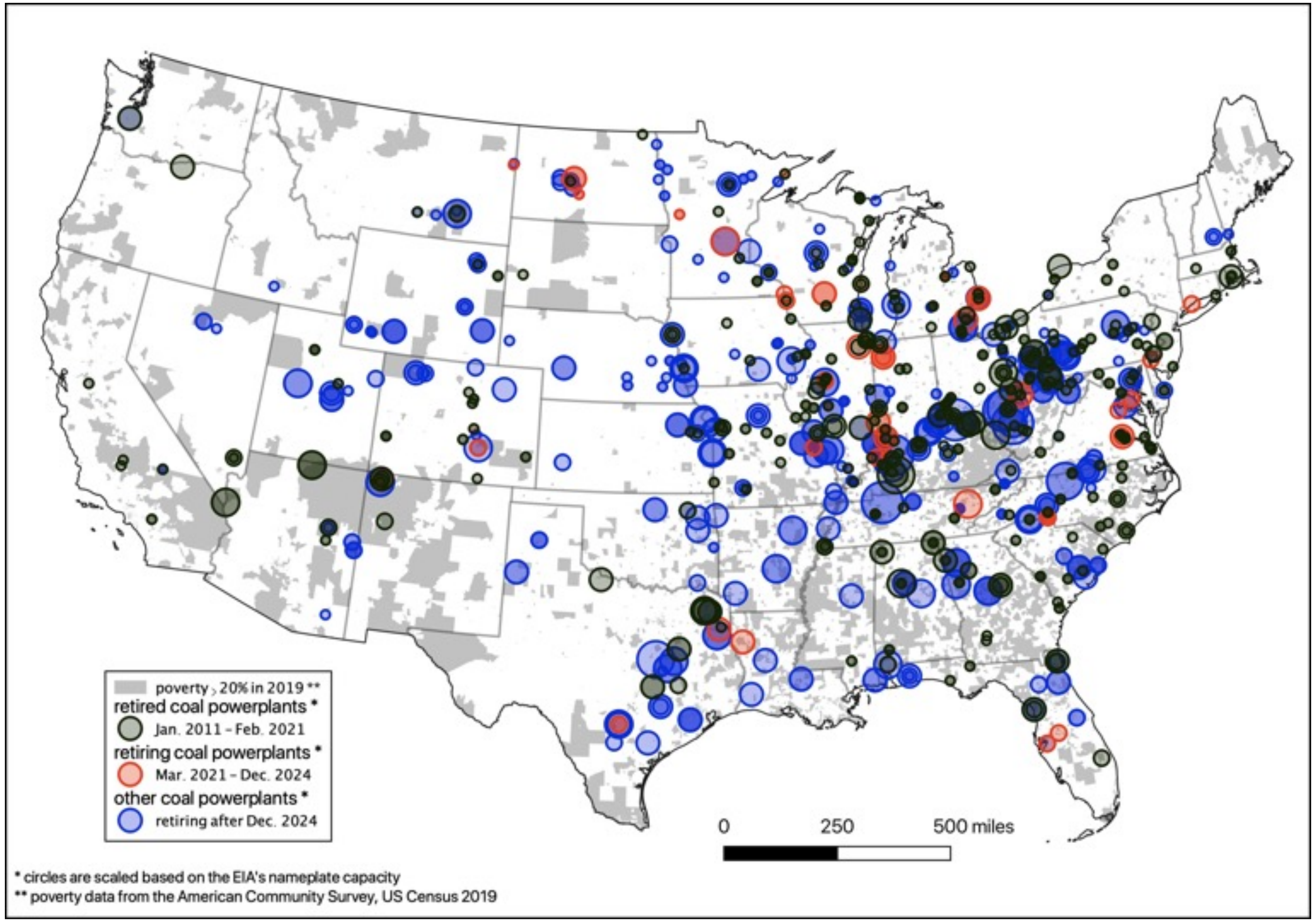
Communities and the Clean Energy Transition

Clean Energy Transition and Decommissioning

- Report I — Business Models for Coal Plant Decommissioning
  https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-31348.pdf

- Report II — Coal-dependent Communities in Transition: Identifying Best Practices to Ensure Equitable Outcomes
  https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-31909.pdf

- **Communities in Energy Transition**
  https://www.pnnl.gov/projects/energy-equity/communities-energy-transition



Recent and planned retirements for coal-fired power plants (2011–2024), operating plants with probable retirement post 2024 overlaid on poverty rate in the region.

Energy Storage Role
Maintains Transitional and Enhances Local Value

Benefit Title	Benefit category(ies)	Description
Emissions reduction	Environmental	The emissions reduction impact of storage installations is dependent on how the storage system is charged. Storage facilitates the removal of fossil fuels from the grid through decommissioning strategies and renewable energy expansion, resulting in significant emissions reduction (Arabzadeh, et al. 2019).
Energy costs	Economic, social	For storage that is replacing fossil-fueled systems, utilities can minimize safety-related emergency calls and avoid fines related to environmental compliance. Peak demand currently results in demand charges to time-of-use (TOU) rates. Storage creates a resource to manage peak demand. Both instances reduce the cost to provide energy and the utility can pass on saved costs to ratepayers. As energy becomes more affordable to the ratepayer, the utility also saves costs by avoiding ratepayer collections and terminations (Woods and Stanton 2019).
Equity enhancement	Social, economic	Storage systems, if implemented with appropriate strategies, can provide targeted benefits to underserved communities including revenue generation and energy independence to improve energy affordability and reduce energy burden (Union of Concerned Scientists 2019, Tarekegne, O'Neil and Twitchell 2021).
Increased property value	Economic	For ratepayers with storage installed in buildings, storage provides the capability to keep heating and cooling systems reliably operational and may decrease energy costs leading to an increased property value. A study by the Appraisal Journal found that for every $1 decrease in the annual utility bill, property value increases by approximately $20 (NREL 2008). A meta-analysis study (Brinkley and Leach 2019) of energy infrastructure impact on housing value found a consistent positive property value impact for rooftop solar, a corollary to residential storage installations .
Job creation	Economic, Social	Storage creates job opportunities across the asset's lifecycle, including battery manufacturing, operation, maintenance, and management. The California Energy Storage Alliance (CESA) reported that energy storage projects in California have supported approximately 20,510 jobs and they project that number might increase up to 113,190 jobs in the next ten years (Noh 2020). Job creation benefits of energy storage could support communities in revitalizing their economies. This is especially critical for regions that will be negatively impacted by the energy transition. For example, in the Centralia case study, the decision to build storage capacity in the plant decommissioning strategy led to research and development efforts creating jobs and work opportunities in the storage supply chain (Centralia Coal Transition Grants 2021).
Less land use	Environmental, Social	Utilizing energy storage to manage increasing power requirements (baseload and peak demand) decreases the need to build new or maintain existing power plants. Decreasing the land required for power plants allows communities to use the now available land for alternative public-serving uses including parks, conservations, commercial and residential facilities, health centers, schools, and recreation centers (Woods and Stanton 2019).
Resilience benefits	Social, Economic	The main resilience benefit is avoided energy outages and the resulting avoided disruption costs (financial and otherwise). For ratepayers, the avoided disruptions are in day-to-day life activities. However, there are currently limited metrics to assess the impacts despite their significance. For example, power outages can create life-threatening risks for vulnerable customers that rely on electronic devices, such as the elderly who require refrigerated medication. Currently, the "value of lost load" (VOLL) is used to estimate the avoided outage benefits to participants (Woods and Stanton 2019). Future valuation methods need to capture the avoided outage benefits of storage in critical and community-serving facilities such as hospitals, senior housing, community centers, schools, and emergency shelters (Rutgers 2019).

Energy Storage for Social Equity: Capturing Benefits from Power Plant Decommissioning
https://www.pnnl.gov/sites/default/files/media/file/Energy%20Storage%20for%20Social%20Equity%20Case%20Study.pdf

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Manager of the DOE Energy Storage Program

Thank you

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Our Vision for Equitable Power Grid:
https://www.pnnl.gov/projects/energy-equity

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Backup

ES4SE TA Overview

OBJECTIVE

Provide technical assistance (TA) to disadvantaged communities to advance energy equity by identifying energy challenges and achieving community-defined goals

GOAL

Transition communities from problem to solution-identification through technical analysis and partnership development

PROCESS

- Pacific Northwest National Laboratory and Sandia National Laboratories provide TA through in-kind guidance, training, analysis, and support
- Utilize group forums for TA participants to connect, share, and learn from other participants

Technical Assistance (TA)

Lead: PNNL
Number of communities selected: **up to 15**

TA will vary based on project, but options may include:

- Energy Analysis
- Economic Analysis
- Grant/funding application assistance

All TA is accompanied by equity and workforce analysis

TA is free to selected communities but is <u>not</u> accompanied by funding

ES4SE Timeline

Phase 1

Application Interest From Deadline
November 5th 2021

December 3rd 2021
Application Deadline

Application Decisions
February 2022

March-December 2022
Technical Assistance Conducted

ES4SE Closing Webinar
December 2022

Phase 2

PDDA Criteria Review
4 to 8 Weeks

4 to 8 Weeks
Meet with Successful Candidates

SNL PDDA Start
8 to 12 weeks

Equity and Workforce Analysis

Discovery

- Baseline study
- Identify metrics and key indicators

Planning

- Community engagement in setting goals
- Estimate how storage might have an impact

Accountability

- Post-deployment outcome assessment
- Accountability to stakeholders
- Feedback to DOE